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To the INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY
LETTER ACCORDING TO RULE 66 PCT

Dear Sirs,

Re: PCT/FI2004/000201
APPLICANTS: M-REAL OYJ et al.

Referring to the written opinion of 15 April 2005, we respectfully submit the following:

Attached new pages 29 to 33 replace pending pages 29 to 32.
New claims 1 and 16 replace the pending claims bearing the same numbers.

The set of claims has been amended in view of the comments by the Authorized officer. Thus, new claims 1 and 16 have been restricted to concern paper and cardboard products in which the second layer is fitted below the surface of the products.

Basis for these amendments can be found in the description, for instance on page 3, lines 5 and 6. As can be noted, it is stated at the cited passage that it is preferred that the second layer "is fitted below the surface of the paper or cardboard product".

No new matter has been introduced.

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The present invention concerns a multilayer product, which comprises a first layer formed by cellulosic or lignocellulosic fibres of the kind which conventionally are used in paper or cardboard products. On top of the first layer, or at a small distance therefrom, e.g. linked by a tie layer to the first layer, there is arranged a second layer which is formed by a conductive polymer mixed with a binder, which forms a matrix. According to new claim 1, it is now further required that the second layer is fitted below the surface of the product.

The surface of the product can comprise layers of at least two basic kinds.

The first option is offered by laminates of the type described on page 3 (penultimate paragraph) and page 14 (last paragraph) – cf. also claims 5 and 18. Such laminates consist of at least two fibrous layers, which are glued together with a binder containing a conductive polymer.

The second option comprises bringing a layer of a third material upon the multilayer product (cf. the paragraph bridging pages 5 and 6). That layer can be applied on one of the fibrous surface layers of the above-mentioned laminate, or it can be applied directly on the binder-layer.

The third layer can be formed by a plastic film or by a coating layer brought upon the product by conventional paper or cardboard coating technique (cf. page 6, first full paragraph).

Common for the above embodiments is that the second layer, which contains the conductive polymer is hid underneath the surface of the paper or cardboard product. The surface layer will protect the polymer and prevent it from scratching, for example. As explained in the penultimate paragraph on page 3 and in the paragraph bridging pages 5 and 6, the surface layer also gives properties of barrier or sealability and – importantly – it forms a substrate for printing of the product.

References D1 and D2 concern highly specific products, viz. "imaging elements", more specifically photographic papers. Such products are commonly produced by a slow process, not at high-speed conditions as the present papers or cardboards, which basically comprise conventional laminates or coated products useful as printing papers or for packaging.

A common problem of known products containing conductive polymers is discussed on pages 1 and 2 of the description. That problem relates to the fact that the conductive polymer is conventionally too loosely bonded to the fibrous matrix. Any polymer released from the paper or cardboard during production will give rise to considerable contamination problems at a conventional paper or cardboard machine – it will end up in the circulation streams and contaminate the headbox as well as the pressing and drying sections.

The present invention solves this problem basically by mixing the conductive polymer into a binder which will provide for proper attachment of the polymer to the cellulosic fiber layer. However, the preferred embodiment, which now is defined in the independent claims, will give addition protection of the layer and at the same time form a printing surface which makes it possible to print on the paper or cardboard product visual markings which refer to

the layer of the electrically conductive polymer. Such markings will make it possible for a consumer or wholesaler to check the origin of the product packed or wrapped in the paper or cardboard.

The use of a binder as a medium for applying the conductive polymer onto paper or cardboard substrates achieves also other advantages. Such an advantage is, for example, that the binder will level out any roughness of the fibrous layer. Further, by mixing of the conductive polymer into a binder, the consumption of the polymer can be reduced, because the binder will evenly spread out over the substrate already at low concentration.

The present products are readily manufactured. In the references, the two layers of the imaging element are always produced in two separate stages. According to the invention, the product can be produced on a conventional paper or cardboard machine by first forming the fibrous layer, then applying a polymer-containing binder on the layer, and subsequently a further fibrous layer on the binder layer or a coating or plastic film layer on the binder layer, all of these steps being carried in one run on the same machine.

As far as printing of the surface is concerned, a particular important advantage of having the second layer hid under the surface of the product relates to the fact that most, if not all, of the conductive polymers have a strong and distinctive colour, which may not be the colour desired for printing purposes. By hiding the layer under a white or whitish coating colour layer or fibrous layer, the surface can be given the predetermined graphical design without any interference from the conductive polymer. However, since both the coating colour and, in particular, the fibrous layer are porous, any alkaline or acid medium used for the printing will migrate at least to some extent through the surface into the binder layer and achieve doping or dedoping of the conductive polymer (cf. page 6, lines 2 to 5). As a result, a pattern or conductivity or non-conductivity will be created in the second layer. Such a pattern can be used as a security mark for the product.

With reference to the above, favorable consideration of the patentability of the invention is solicited. If there are still outstanding matters, we would ask for a further opportunity to provide arguments and comments.

Yours faithfully,
Seppo Laine Oy

Christoffer Sundman

Enc.: amended pages 29 to 33

Claims:

1. Multilayered paper or cardboard product comprising
   - at least one first layer, which is formed by cellulosic or lignocellulosic fibres, and
   - at least one second layer, which is fitted adjacent to the first layer or at a distance therefrom,

characterized in that
   - the second layer is fitted under the surface of the product and
   - it contains a synthetic, electrically conductive polymer, which is mixed with a binder which forms a binder matrix,

whereby the second layer is at least partially electrically conductive.

2. The multilayered product according to claim 1, characterized in that the binder forms a homogeneous mixture together with the electrically conductive polymer.

3. The multilayered product according to claim 1, characterized in that the binder of the second layer comprises a binder that dissolves or disperses in water.

4. The multilayered product according to claim 3, characterized in that the binder comprises dextrin, carboxymethyl cellulose, poly(vinyl alcohol), poly(vinyl acetate) or a binder based on starch or a starch derivative.

5. The multilayered product according to any of the preceding claims, characterized in that it comprises two first layers which have been bonded together by a second layer fitted inbetween them.

6. The multilayered product according to claim 5, characterized in that the first layers are formed by fibrous webs.

7. The multilayered product according to claim 6, characterized in that the fibrous webs are formed by unsymmetrical paper or cardboard webs.

8. The multilayered produced according to any of the preceding claims, characterized in that it further comprises a third layer which is arranged on top of the first or the second layer.

9. The multilayered product according to claim 8, characterized in that the third layer is formed by a plastic film, which has been extruded on the surface of the product.

10. The multilayered product according to claims 8, characterized in that the third layer is formed by a layer of a coating colour.

11. The multilayered product according to any of the preceding claims, characterized in that the second layer contains an electrically conductive polymer selected from the group of polyaniline, polypyrrol and polythiophene.

12. The multilayered product according to any of the preceding claims, characterized in that concentration of the electrically conductive polymer in the second layer is about 0.1 to 10 weight-%.

13. The multilayered product according to claim 12, characterized in that surface resistivity of the second layer is about 10exp2 to 10exp11 Ohm.

14. The multilayered product according to any of the preceding claims, characterized in that the electrical conductivity of the electrically conductive polymer of the second layer is locally adjusted to form a pattern of electrical conductivity or electrical non-conductivity, respectively.

15. The multilayered product according to any of the preceding claims, characterized in that the surface of the multilayered product is provided with a visual marking which indicates the layer containing the electrically conductive polymer.

16. Method for producing a multilayered paper or cardboard product, which method comprises producing

- at least one fibrous layer, which is formed by cellulosic or lignocellulosic fibres, and

- at least one layer of an adhesive agent arranged on top of the fibrous layer below the surface of the product,

characterized in that

- the layer of the adhesive agent is formed from a mixture, which contains synthetic, electrically conductive polymer, which is mixed with a binder, and
- this mixture is applied upon the fibrous layer.

17. The method according to claim 16, characterized in that binder mixture is applied as an at least partially continuous layer on top of the fibrous layer and is allowed to attach thereto.

18. The method according to claim 16 or 17, characterized in that the binder is used for attaching two fibrous layers to each other.

19. The method according to any of claims 14 to 18, characterized in that the electrically conductive polymer is mixed in the form of a dispersion into the binder.

20. The method according to any of claims 14 to 19, characterized by producing a binder mixture in which the concentration of the electrically conductive polymer is about 0.1 to 10 % of the weight of the mixture.

21. The method according to any of claims 14 to 20, characterized in that the binder is water-soluble or water-dispersable, and it comprises, e.g., dextrin, carboxymethyl cellulose, poly(vinyl alcohol), poly(vinyl acetate) or a binder based on starch or a starch derivative.

22. The method according to any of claims 14 to 21, characterized in that the electrically conductive polymer is used in doped form.

23. The method according to claim 22, characterized in that the electrically conductive polymer is mixed with the binder at acid pH, preferably at a pH of 1 to 6.5.

24. The method according to any of claims 14 to 23, characterized in that

the surface resistivity of the binder layer formed can be adjusted to a value in the range of 10exp2 to 10exp11.

25. The method according to any of claims 14 to 24, c h a r a c t e r i z e d in that the binder mixture is applied on a fibrous web having a pH of 8 at the most.

26. The method according to any of claims 14 to 25, c h a r a c t e r i z e d in that the electrical conductivity of the polymer is changed by doping the electrically conductive polymer or by dedoping the electrically conductive polymer, respectively.

27. The method according to claim 26, c h a r a c t e r i z e d in that the electrically non-conductive polymer is doped by treating the polymer layer with an acid solution, which is used for painting a desired pattern on the surface of the paper or cardboard product.

28. The method according to claim 26, c h a r a c t e r i z e d in that the electrically conductive polymer is dedoped by treating the polymer layer with an alkaline solution, which is used for painting a desired pattern on the surface of the paper or cardboard product.

29. The method according to any of claims 26 to 28, c h a r a c t e r i z e d in that electrically conductive polymer is doped by printing a desired pattern on the surface of the paper or cardboard product by using a printing colour which is capable of doping or dedoping the electrically conductive polymer.

30. The method according to any of claims 14 to 29, c h a r a c t e r i z e d in that a pattern is printed on the surface of the paper or cardboard product for indicating how the electrical condutivity of the second layer can be detected.

31. The method according to any of claims 14 to 30, c h a r a c t e r i z e d in that a third layer is fitted upon the first or the second layer.

32. The method according to claim 31, c h a r a c t e r i z e d in that the third layer is formed by a plastic film, which is extruded on top of the product.

33. The method according to claim 31, c h a r a c t e r i z e d in that the third layer is formed by a layer of a coating colour.